ECOMETRICS ANALYSIS REPORT:

COMPARISON OF NATIVE GRASSES VS NON-NATIVE GRASSES FOR RIGHT-OF-WAY RESTORATION

PREPARED FOR: TEXAN BY NATURE- EOG RESOURCES

Texas

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COMMISSIONED BY: TEXAN BY NATURE ON BEHALF OF EOG RESOURCES

EcoMetrics

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Table of Contents

Tables

Figures

EcoMetrics Analysis Disclaimer

Financial Information

This report represents an analysis of potential benefit value created in accordance with the scope, steps, and caveats explained herein. Even when certified by SVI, this report is not a formal financial analysis that has been reviewed by financial auditors or is aligned with all investment accounting principles. The results are intended to inform business decisions and to help create a business case for possible project investment. For cases where portions of an EcoMetrics report may be used more formally, such as to support carbon sequestration rates for entry into a registry program or a state regulated water quality trading program, other specific methodologies may need to be used and noted accordingly in the report in the applicable sections.

Stakeholder Participation

The EcoMetrics analysis approach relies heavily on the participation of key project stakeholders. Stakeholder participation is completely voluntary, which in turn may not always provide us with a stakeholder group's perspective in its completeness or reflect the opinions of all others in their groups. As EcoMetrics maintains a third party, objective stance in the project, the perspectives presented in this report do not reflect the views or opinions of the authors.

Recommendations Provided

EcoMetrics LLC is a third-party entity that only evaluates project value creation. We are not party to the project or decisions therein. EcoMetrics may assist the client in exploring ways to relate any objective, targets, and indicators to metrics presented in our reports. This would allow capturing in subsequent evaluation updates results of any progress made. EcoMetrics is in no position to enforce or impose these recommendations or strategies and takes no responsibility for the project outcomes or progress.

1.0 Executive Summary

This report contains the EcoMetrics analysis of a pilot project to study the relative differences in outcomes and impacts associated with using native grasses vs non-native grasses for oil and gas right-of-way restoration in Texas. This project was conducted on behalf of Texan by Nature (TxN) who is interested in promoting more use of native grasses based on the hypothesis that native grasses provide better ecosystem benefits and create more net value than non-native grasses.

The test plots were on EOG Resources Inc. (EOG) right-of-way restoration acres in the Eagle Ford play producing area in South Texas. The area of the tests consists of privately held, active grazing rangelands and grasslands. In Texas, oil and gas companies are required to work with landowners to restore land disturbed by exploration and production activities. These areas include well pads and pipeline rights-of-way. Restoration can use non-native grasses, which cost less per acre in terms of seed and planting costs but end up providing less overall value long-term in terms of related co-benefits. The project intended to run several test plots of both native and non-native grasses and quantify the differences in biophysical parameters such as carbon sequestered, soil and water runoff, and biodiversity. The EcoMetrics analysis was to build on that biophysical analysis and determine and compare the value of the impacts associated with using one type of grass over the other.

TxN commissioned Texas A&M University's Natural Resources Institute (NRI) to collect and analyze data on various biophysical parameters across several test plots where controlled analysis of native and non-native grasses could be conducted. One of the purposes of the analysis was to inform the EcoMetrics analysis.

This project was more a "Proof of Concept" than a full site application. The intent is to use the results to generally demonstrate the relative value of native grasses vs non-native grasses. The results of the EcoMetrics analysis showed that collectively, *native grasses provide more benefits with greater aggregated value than non-native grasses*. This information can be used to promote the use of native grasses, although the actual benefits and specific values would need to be determined for specific cases.

The results presented are normalized values as value/acre, realizing the test plots are relatively small in terms of acres and do not represent a large area. It is also important to note that the specific application is for oil and gas right-of-way restoration, and these tend to represent small percentages of some of the larger land holdings, such as those typical of Texas ranches. For these two reasons, the absolute value created is not as representative as the comparison of normalized values per acre for native grasses vs non-native grasses. However, the absolute value is helpful in that these test plots were also for actual required right-of-way restoration of EOG activities on private land.

The project involved several partners. EcoMetrics was retained to identify, quantify, and value the outcomes of each approach and provide a comparison with the intent to compare total benefit value created by native grasses vs non-native grasses and compare that to relative costs of each to determine comparative Return on Investment.

1.1 Valuing Benefits

The comprehensive benefits of the different grass types – which include social, economic, and environmental outcomes – were identified, quantified, and valued utilizing the EcoMetrics methodology. EcoMetrics identifies, quantifies, and values environmental, economic, and social benefits and incorporates the guiding principles of Social Value International's (SVI) Social Return on Investment (SROI) Methodology. The major stakeholder groups who would benefit include:

- The Environment
- Corporations
- Conservation Groups
- Local Government Agencies
- Education and Research
- Funder
- Landowner
- Local Business

The analysis revealed three key highlights:

1. **The findings revealed that overwhelmingly, the native grasses create a greater aggregated value per acre ($1,224/acre) than non-native grasses ($930/acre) (Table 1).**

The comparison was based on native vs non-native hence a positive outcome net value means that the native grass creates more value per acre than non-native. There are two exceptions- one is soil stabilization which is based on NRI soil runoff information, and the financial proxy is based on cost/ton of runoff. The lower per acre value for native grasses means less runoff occurs, which is "less negative" and therefore a positive outcome. The other exception is grazing value per acre where the non-native per acre value is greater due to variations in cow density per acre.

2. **The results indicate that promoting native grasses for oil and gas right-of-way restoration will provide more value for more stakeholders, including the landowner, even if the seed, planting, and maintenance costs are greater.**

The comparative annual per acre values presented in Table 1 are conservative in that, for some outcomes, even where the values seem similar for native and non-native grasses based on the same per unit cost and number of acres, the true value is greater for native grasses. This is because the NRI analysis indicated that the quantity of these benefits is greater in terms of density per acre. For example, the financial proxy for biodiversity is the same per acre for both native and non-native grasses. However, the NRI results show that biodiversity is 30% richer for native grasses and therefore the real value differential is approximately 30% greater. For financial proxies based on some other parameter rather than acres, this is accounted for in the valuation. For example, carbon is based on cost per ton, and NRI determined tons per acre.

Table 1: Comparative Annual per Acre Values of Outcomes for Native vs Non-native Grasses

Stakeholders	Outcomes	Annual per Acre Non-Native ($)	Annual Per Acre Native ($)	Annual per Acre Native minus Non-Native ($)
Academia/ Research	Scientific Education	$0	$28	$28
Total Academia/ Research		$0	$28	$28
Environment	Total Soil Stabilization*	$(-0.76)	$(-0.27)	$0.49
	Total Soil Formation	$3	$4	$1
	Total Waste Treatment	$43	$118	$75
	Total Water Filtration**	$12	$25	$13
	Total Nutrient Cycling	$8	$12	$4
	Total Biological Control	$63	$63	$0
	Total Pollinator Population Support	$6	$25	$19
	Total Habitat and Biodiversity**	$19	$40	$21
	Total Water Regulation**	$4	$11	$7
Total Environment		$157	$298	$140
General Public	Total Cultural and Aesthetic Value	$42	$108	$66
	Total Air Quality - Other GHG	$115	$115	$0
	Total Carbon sequestration- social value	$1	$2	$1
	Total Nitrogen Retention- social value**	$30	$76	$30
	Total Phosphorus Retention- social value	$424	$424	$0
	Total Land Management Incentives / Insurance	$13	$13	$0
Total General Public		$625	$738	$97
Local Economy	Total Wildfire Risk Reduction	$53	$53	$0
	Total Value of Livestock Grazed**	$44	$18	$(-23)
Total Local Economy		$97	$71	$(-23)
Local Government	Water Supply/Quantity	$34	$64	$30
Total Local Government		$34	$64	$30
Funders	Total Market value of Carbon Credits	$1	$1	$0
	Total Market value of Nitrogen Credits**	$8	$16	$8
	Total Market Value of Phosphorus Credits	$8	$8	$0
Total Funders		$17	$25	$8

Total Value Created	**Non-Native Annual Per Acre**	**Native Annual Per Acre**
Non-Market Total Present Value	$913	$1,199
Market Total Present Value	$17	$25
Total Value	$930	$1,224

*Soil Stabilization is based on NRI soil runoff information, and the financial proxy is based on cost/ton of runoff. The lower per acre value for native grasses means less runoff occurs, which is a positive outcome.

** Corrected proxy value-equivalent based on NRI quantification analysis

3. **The NRI study provided highly valuable quantification information of key biophysical parameters that allowed for more accurate adjustments of projected benefits quantification and valuation proxies and methodologies.**

Typically, such accurate and site-specific information is not available. Having this information to do this comparative analysis will more accurately inform future project assessments of native vs non-native grasses use for restoration. Table 2 illustrates the adjusted annual per acre value to account for this quantification variation as per the NRI study.

Table 2: Adjustments to Outcome per Acre Values Based on NRI Analysis

Outcome	Relation to NRI Data	Per Acre Value from Proxy ($)	Percent Native over Non-Native (%)	Corrected Per Acre Value Based on NRI ($)
Soil Stabilization	Sediment Runoff	$(-1.2)	60%	$(-0.76)
Water Filtration	Infiltration Rate	$12	114%	$25
Biodiversity/Habitat	Observation Counts	$19	116%	$40
Water Regulation	Surface Runoff	$4	153%	$11
Nitrogen Retention	Nitrates	30	100%	$76
Grazing Nutrition	Biomass	$44	(-53)%	$18

2.0 Benefits Valuation Background

2.1 Purpose of Benefits Valuation of Native vs. Non-native Grasses

TxN contracted with EcoMetrics LLC to complete the comparative SROI analysis as a means of assessing and valuing the various co-benefits between native and non-native grasses. The EcoMetrics™ methodology identifies, quantifies, and values (in monetary terms) the social, economic, and environmental benefits of investing in nature-based solutions. The model combines quantitative and qualitative values across numerous social, economic, and environmental categories to forecast the relative social and economic outcomes for corporations interested in investing in reforestation projects. The EcoMetrics model was built on the guiding principles of SVI's SROI Methodology and the International Integrated Reporting Council's (IIRC) International Integrated Reporting Framework.

Stakeholder relationships are of primary importance to both methodologies. The SVI approach concerns an in-depth, evidence-based understanding of change for a full range of relevant stakeholders with recognition of both positive and negative changes as well as intended and unintended outcomes. Value in this context refers to the relative importance placed by a stakeholder group on one potential outcome over another. Assigning these valuations using SVI principles requires the use of financial proxies, as many of the identified outcomes are difficult to quantify using conventional accounting practices. The IIRC methodology is principally concerned with value creation for funding stakeholders and resources are allocated based on the potential benefit to the corporation and quantified using conventional accounting practices. For this project, we leveraged the SVI methodology.

The objectives of this project were to use the SROI methodology to:

- Identify and engage relevant key stakeholders affected by the use of grass types – Understand what each stakeholder wants changed (objectives), what they contribute (inputs), what activities they do (outputs) and what changes for them (outcomes, intended or unintended) as a result of their involvement;

- Measure and value the impacts of restoring with either grass type – Understand the value created as a result of the changes experienced by each stakeholder group by using indicators to measure and quantify the outcomes and financial proxies to value the outcomes; and
- Create a forecast analysis to measure and evaluate the impacts of native vs non-native grasses – Articulate the key drivers of value creation and identify what data are needed to best measure and evaluate the impacts of activities.

To fully measure and evaluate the impacts of using different grass types for restoration, this research incorporates scientific data on the objective impacts into the SROI evaluation. These data are directly tied to the outcomes defined by the key stakeholders and used to quantify the social value of environmental change. The SROI methodology presents these social values in terms of financial equivalents, which allows stakeholders across the board to evaluate the cost/benefit favorability or unfavorability of proposed environmental interventions. Such valuation of outcomes will allow TxN, EOG, and others to understand the internalized financial benefits and externalized societal benefits of making investments in natural capital.

This report provides a brief overview of the SROI methodology, project approach, the objectives and activities of the comparative analysis of grass types, and the key findings and assumptions made when completing the analysis. Finally, this report includes a discussion of the SROI results and recommendations. The audience for this SROI report is the project partners. However, partners intend to use this study to communicate the impact to other potential funders and stakeholders.

2.2 Social Return on Investment (SROI) Approach

SROI is a framework for measuring and accounting for the broad concept of social value, a measure of change that is relevant to people and organizations that experience it. This concept of value goes beyond what can be captured in pure, market-based financial terms, seeking to reduce inequality and environmental degradation and improve wellbeing by incorporating social, environmental, and economic costs and benefits into project valuation (SROI Network, 2012). For analytical purposes, SROI converts non-financial values into their financial equivalents, using both subjective and objective research to estimate those values. EcoMetrics LLC believes this is what makes SROI different from other forms of social-impact analysis, and therefore more valuable to funders and supporters.

There are two types of SROI analysis:

- Forecast, which is designed to understand and predict the desired impact and outcomes of an activity for significant stakeholders.
- Evaluative, which is conducted to set the baseline and/or retrospectively to validate a forecast or baseline SROI to understand if the impact sought was achieved.

Forecast SROIs are especially useful in the planning stages of an activity. They can help show how investment can maximize social impact and are also useful for identifying what should be measured once the project is implemented (SROI Network, 2012). This TxN project is a predictive analysis to determine the relative impacts if native grasses are used instead of non-native grasses for restoration of land disturbance due to oil and gas operations.

SROI was developed from social accounting and cost-benefit analysis and is based on the eight published principles of social value (SROI Network, 2012):

1. Involve stakeholders – Inform what gets measured and how this is measured by involving stakeholders;
2. Understand what changes – Articulate how change is created and evaluate this through evidence gathered, recognizing positive and negative changes as well as those that are intended and unintended;
3. Value things that matter – Use financial proxies in order that the value of all outcomes can be recognized including those that are not traded in markets but are affected by activities;
4. Only include that which is material – Determine what information and evidence must be included in the accounts to give a true and fair picture, such that stakeholders can draw reasonable conclusions about impact;
5. Do not over-claim – Only claim the value that organizations are responsible for creating;
6. Be transparent – Demonstrate the basis on which the analysis may be considered accurate and honest, and show that it will be reported to and discussed with stakeholders;
7. Verify the result – Ensure appropriate independent assurance; and
8. Be Responsive – Pursue optimum value based on decision making that is timely and supported by appropriate accounting and reporting.

The SROI process works by developing an understanding of the activity being analyzed, how it meets its objectives, and how it works with its stakeholders. The SROI framework accounts for a broad concept of value and focuses on answering five key questions (Table 2):

Table 2: Key Questions Addressed by SROI Framework

Question	Definition
Who changes?	Taking account of all the people, organizations, and environments affected significantly
How do they change?	Focusing on all the important positive and negative changes that take place, not just what was intended
How do you know?	Gathering evidence to go beyond individual opinion
How much of this change do you cause?	Taking account of all the other influences that might have changed things for the better (or worse)
How important are the changes?	Understanding the relative value of the outcomes to all the people, organizations, and environments affected

SROI puts a value on the amount of change (impact) that takes place as a result of the activity and looks at the returns to those who contribute to creating the change and others who benefit from it. It estimates the value for this change and compares this value to the investment required to achieve that impact, resulting in an SROI ratio. It takes standard measures of economic return a step further by placing a monetary value on social returns (Social Ventures Australia, 2011). The development of an impact map demonstrating the impact value chain for each stakeholder group is critical to this process. It links stakeholders' objectives to inputs (e.g., what has been invested), to outputs (e.g., number of acres restored), through to the outcomes (e.g., increase in biodiversity). The process then involves identifying indicators for the outcomes, so that we can measure if the outcome has been achieved. The next step is to use financial proxies to value the outcome.

It is then necessary to establish the amount of impact each outcome has had. Impact is defined in the SROI as an estimate of how much of the outcome would have happened without the project and the proportion of the outcome that can be isolated as being added by the activities being analyzed. A number of filters are utilized in the analysis to render additional validity and stability to the conversion of non-market social values into their financial equivalents. SROI uses four filters applied to each outcome to establish the impact of the activities. Because this was a comparative analysis and not a typical SVI defined "before and after analysis", not all of these corrections are applicable. Further explanation is provided in Section 7.5

- Deadweight – What would have happened anyway?
- Displacement – Were other existing outcomes displaced to create the outcome?
- Attribution – Who else contributed to the outcome beyond those who funded and own the project?
- Drop-off – How much does the outcome drop-off each year?

Establishing impact is important as it reduces the risk of over-claiming and may also help identify any important stakeholders that may not have been included in the initial analysis.

2.2.1 SVI Certification

SVI provides an option where the entire work product is independently reviewed, and assurance and verification provided as reflected by certification of the work. This verification does not replace any benefit-specific independent assurance requirements that may be necessary based on how the information is used. For example, a carbon registry may require some degree of verification and validation of carbon sequestration claims. EcoMetrics can be aligned with such requirements for specific uses to facilitate that type of assurance. The SVI certification is an additional, overall level of independent assurance. The SVI certification is not required but is important in that it focuses on the socio-economic valuation and validates that stakeholder engagement was robust and appropriate.

2.3 SROI Research Approach

The analysis was undertaken in six stages. These stages and the activities completed in each of them are listed below:

1. Establish scope and identify stakeholders
    a. Define boundaries and time scale for analysis
    b. Define stakeholders
2. Map outcomes
    a. Engage with stakeholders to develop a preliminary impact map that shows the relationship between objectives, inputs, outputs and benefits/outcomes
3. Evidence outcomes and give them a value
    a. Synthesize data from stakeholder engagement into a virtual impact map

   b. Identify relevant indicators and financial proxies to monetize the benefits, where possible
   c. Define the investment, both direct cash investments and pro bono contributions from the various stakeholders
   d. Conduct follow up interviews to verify evidence where required
   e. Test assumptions with key relevant stakeholders
4. Establish impact
   a. Determine those aspects of change that would have happened anyway or are a result of other factors
5. Calculate the benefits' value
   a. Populate and use the EcoMetrics platform to sum the benefits, subtract any negatives and compare the result to the investment. This is also where the sensitivity of the results is tested as necessary.
6. Report, use and embed
   a. Prepare a detailed report which describes the methodology, assumptions made, results and recommendations
   b. Complete summaries of the SROI analysis
   c. Report to stakeholders, communicate and use the results, and embed the SROI process in the organization

2.4 Unique Aspects of Applying the SROI Methodology to Nature-Based Solutions

Nature-based solutions, including those associated with preserving, conserving, and restoring natural settings and land covers, introduce the concept of ecosystem services-related benefits. An ecosystem service is simply a positive impact or benefit that nature provides to society. These can be direct or indirect and fall into a number of categories. For example, a direct service is the natural surface water filtration by wetlands or the carbon sequestration capacity of vegetation. An indirect service is recreational value or overall well-being. The nature of grasses provides many ecosystem services, most notably wildlife habitats, groundwater recharge areas, and carbon sequestration of the various land cover types.

In general, and for the purposes of this analysis, ecosystem services, green infrastructure, and other ways to leverage nature and natural resources are collectively referred to as nature-based solutions. Recognizing the benefits associated with nature-based solutions allows us to quantify and value those benefits, demonstrating that protecting such areas actually does create and preserve value. The valuation also allows comparison between nature-based solutions and more traditional built infrastructure.

Efforts with environmental and nature-based solutions attributes are different than typical SROI-related projects. Benefits tend to focus on changes to the environment and natural ecosystems, which in turn have impact and provide benefits to a variety of stakeholders. Applying the SROI methodology to environmental projects, however, poses unique challenges. The SROI methodology has historically been used by community organizations focused on social welfare programs which have a clearly defined period of investment and an associated commensurate period of benefits (Social Ventures Australia Consulting, 2011). With nature-based solution environmental projects, many of the benefits are often not readily or immediately apparent to stakeholders. For example, the assignment of carbon, nitrogen, and phosphorus offset credits provides direct benefits to the funders and partners. However, the environmental value of carbon, nitrogen, and phosphorus for other stakeholders and society at large are generally not identified as outcomes through stakeholder engagement.

To account for these more intangible assets, the environment is considered as a stakeholder, as though it were a person or an organization. The specific outcomes associated with the environment were derived from scientific literature and research and interviews with government agency officials that are responsible for environmental factors. The results of this research can be considered outcomes that will accrue to various stakeholder groups in the future. However, environmental benefits also have ancillary benefits to other stakeholders and those are noted and accounted for herein.

3.0 Project Background

3.1 Purpose and Background

With approximately 95 percent of land being privately owned in Texas, management of native pollinator habits, water quality and quantity, biodiversity, and many other ecosystem services are the responsibility of landowners and the industry partners that work on private land. Oil and gas operations cause land disturbance especially for well pads and pipeline rights-of-way. These areas must be restored after the development work is complete. Various options exist for restoration, and in cases of active grazing rangelands, the restoration must be compatible with this use. Even though restoring with non-native species of vegetation is allowed, and in most cases less costly, there is value in using native species instead. To accurately compare, not only must one compare seed and installation costs, but also the corresponding value created by each species type.

For this project, TxN partnered with NRI and EcoMetrics LLC on a project funded by EOG, to quantify the environmental and socioeconomic return of restoring rights-of-way in the Eagle Ford Shale play with native vegetation following energy infrastructure development. Through comprehensive data collection of restoration and reference sites, the partners wish to quantify the carbon sequestration differences amongst native and invasive vegetation restoration and understand the socioeconomic investment return on restoring land with native seeds.

In accordance with TxN’s scope, the EcoMetrics analysis is to inform the following goals of the project:

- Quantify and monetize carbon sequestration, water quality and quantity, biodiversity, and socioeconomic benefits of native vegetation restoration on rangelands within the Eagle Ford shale play;
- Compare soil carbon storage across native and invasive plant communities;
- Evaluate the ROI for native vegetation restoration of rights-of-ways versus current restoration techniques;
- Recognize industry partners as an advocate for native vegetation restoration and a catalyst for expansion of native habitat beyond the rights-of way into rural working lands across Texas.

According to TxN, for these practices to become a standard, they must be economically feasible to adopt. Native seed mixes are more expensive than non-native monoculture alternatives that are often invasive in nature and can have negative ecosystem impacts. Incentivizing native vegetation restoration for the energy industry and landowners alike is imperative to success. Quantifying and valuing the benefits of this practice will provide the industry with a tool to measure sustainability and incentivize landowners to conduct native restoration to create carbon credits for purchase, as well as other possible marketable credits.

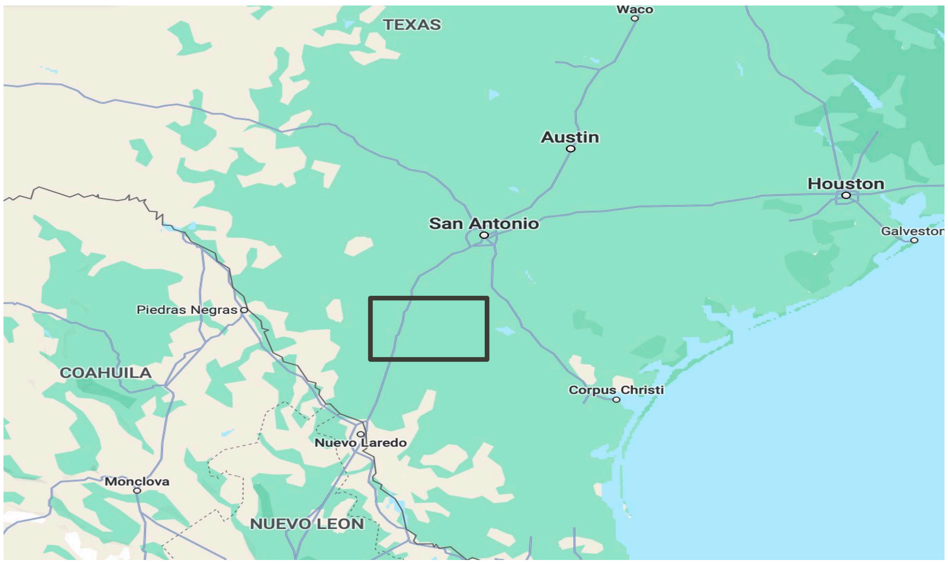

Figure 1: Location Map of Test Areas (Texas, USA)

Figure 2: Project Location

3.2 Partners

The project involved a number of partners, including TxN, EOG, and Texas A&M University-Natural Resources Institute. Additional partners include Texas A&M Blackland Research and Extension Center, Tarleton State University, native seed companies, and Natural Resources Conservation Service (NRCS) and/or Native Prairies Association of Texas.

3.3 Area Description

The test plots were located on active ranches and rangelands in southcentral Texas, south of San Antonio and within the Eagle Ford shale play. The specific plots involved lands disturbed by oil and gas exploration and production activities by EOG. This area is characterized by active rangeland for grazing intermixed with oil field features such as well pads, pipelines, storage tankage, and other infrastructure. It is important to note that the test project was to help catalyze use of native species across Texas, and projects will vary in terms of settings.

4.0 Stakeholder Engagement Methodology

4.1 Identifying Stakeholders

To initiate stakeholder engagement, EcoMetrics LLC and TxN collaborated to create a list of initial stakeholder categories. The stakeholders identified were invited to participate in interviews led by EcoMetrics and were solicited to recommend other critical stakeholders for EcoMetrics to connect with for the engagement process (Table 5). The goal was to talk with a balanced representation of stakeholder groups to best calculate the social impacts and SROI of the project.

Because this project was a comparative analysis of grass types and not a specific project site analysis, stakeholders were based on their relevance to the practice of restoration of disturbed lands. EcoMetrics interviewed the landowners of the test plots in order to get insight on what landowners might think are the impacts of using one grass over the other. However, each actual application of restoration practices will involve different landowners and other geographically relevant stakeholders.

The stakeholder categories capture a diverse cross section of stakeholders involved and/or interested in the potential of native grass restoration to address a number of opportunities, concerns, and interests in the state of Texas and beyond.

Table 3 and Figure 3 show the number and distribution of stakeholders in each group.

Table 3: Stakeholder Groups and Numbers of Represented Stakeholders

Stakeholder Group	Number
Corporations	4
Conservation Group	4
Education and Research	1
Funder	3
Landowner	2
Local Business	2
Local Government	2
Total	18

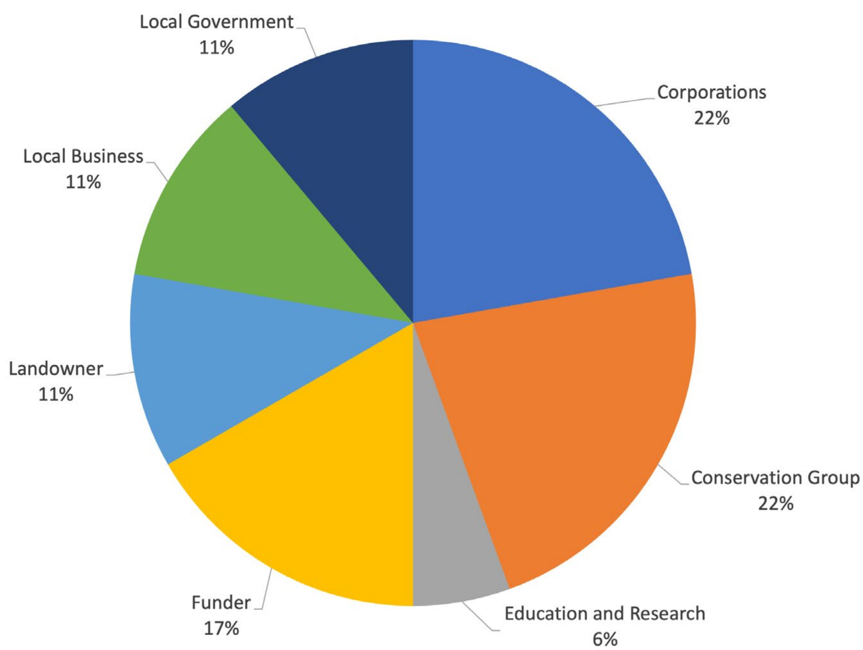

Figure 3: Stakeholder Representation Proportions of Data Collected

4.1.1 Description of Stakeholder Groups

In total, eight core stakeholder groups were identified:

The Environment

The environment is considered a stakeholder, but as it cannot speak for itself, other stakeholder groups, such as government agencies and conservation organizations, can serve as proxy stakeholders. Also, subject matter experts used by EcoMetrics LLC were also used to represent the environment where appropriate.

Corporations

With little data available to demonstrate the quantitative and qualitative benefits of non-native grasses in restoration and/or reclamation projects on various sites of impact, several regional, state and national corporations are interested and intellectually invested in the potential outcomes of this project. These corporations are interested in how potential project outcomes can improve long term management costs, enhance ecological and wildlife goals, promote resilient native landscapes, and potentially advance their social license to operate.

Conservation groups

These conservation organizations include regional non-profit groups that work to support environmental enhancement and restoration projects for at-risk habitats and wildlife. They often work closely with state and regional government officials on environmental projects that have wider ecological impacts. The organizational mission of many of these organizations is to create and sustain programs beneficial to both their membership, the environment, and the general public. Members of conservation organizations generally differ from direct users of the site in that their outcomes are often experienced on a broad ecosystem scale. Conservation organizations can be another proxy stakeholder for the environment. There may be overlap between conservation organizations and education and research opportunities (see below) as some of the entities have education components.

Local Government Agencies

Proper restoration and protected ecosystems and the environment are of interest to a number of state and regional government agencies such as USDA, NRCS and others.

Education and research

Education and research stakeholders are included because native grass test sites provide a learning opportunity for a variety of disciplines across a wide range of age groups. These projects also provide research opportunities.

Funder

The responsible company required to restore the impacted acreage resulting from oil and gas exploration and production activities. Although the restoration is a mutually agreed upon approach, the cost is borne by the oil and gas company.

Landowner

Landowners are considered a significant stakeholder group for the purposes of this project. With 95% of land in Texas privately owned, the landowner perspective is an important consideration for potential future uptick in use of native vs. non-native grasses on various land restoration and/or reclamation applications.

Local business

For the purposes of this report, EcoMetrics has classified the local/regional seed companies as local businesses potentially impacted by the outcomes of this project. Seed business is a significant enterprise in the area as landowners, oil and gas companies, state wildlife agencies and conservation organizations currently use or are interested in the use of native seed mixes or seed mixes with a desired ratio of native and non-native seeds. While native seed mixes tend to be more expensive, there is growing interest from consumers for an authentic supply of locally sourced native seeds for use on the large swaths of private land in the state.

4.2 Outreach Strategies

EcoMetrics worked closely with TxN staff to identify key stakeholders for the pilot project. TxN staff either provided direct introductions and support scheduling one-on-one Zoom interviews or provided contact information needed for the EcoMetrics team to reach out and schedule Zoom interviews. Outreach and engagement with stakeholders occurred between August 2023 and October 2023.

4.2.1 Workshops

None to date

Table 4: Dates of Outreach and Engagement Activities

Date	Activity	Location (if applicable)	Parties Involved
August – October 2023	Individual zoom interviews conducted by EcoMetrics staff	Zoom	EcoMetrics, TxN and individual stakeholders

4.2.2 One-on-One Interviews

EcoMetrics conducted a series of one-on-one interviews via Zoom to record perspectives of the project from different stakeholders. Using a pre-approved interview guide aligned with Social Value International (SVI) principles, each interview mixed qualitative and quantitative questions to be able to measure perceptions of change and outcomes of one grass type over the other, as well as describe what those numerical attributions meant to each participant and their relative stakeholder groups.

4.2.3 Ranking Survey

As part the data collection process, all interviewees were given a brief ranking exercise survey to record value rating responses assessing the current (non-native grass) and future (native grass). EcoMetrics inquired into the current and past use of native and non-native grasses in restoration in the landscape; the environmental/ecological footprint of the area; the historical significance of the area; the possible activities that will occur and what kind of residual impacts this might bring to the area; how the restorations could fit into the existing landscape of environmental management; and the significance to the area, the region, and the county. The specifics of what was asked in the survey are provided in Appendix IV.

5.0 Theory of Change

Typically, a theory of change describes and summarizes the objectives, inputs, outputs, and outcomes related to different stakeholder groups (Social Ventures Australia, 2011). Additionally, theory of change is a pathway linking the short-term, medium-term, and long-term outcomes experienced by these stakeholder groups (Ireland, 2013). The theory of change described here delineates how varying stakeholder groups experience and perceive material change resulting from inputs to outputs, and ultimately to outcomes. The logic flow for the Theory of Change is illustrated in Table 5.

Table 5: SROI Mapping Stages 1 and 2 – The Stakeholders, Inputs, and Outputs

Stakeholder Subgroup (if applicable)	Inputs	Intended / Unintended Changes	Outputs
Environment	Natural ecosystem functions	Changes to various environmental parameters	Enhanced ecosystem services and provision natural resources
Funder	Financial investment	Value creation from native grasses	Revenue, profitability, enhanced reputation
Corporations	Financial capital and support	More sustainable options for land disturbance restoration. Enhanced reputation	Stronger market position, progress towards corporate sustainability goals
Local Business	Good and services	Stronger business resilience and local economic development	More local business viability
Local Government Agencies	Overall support, public trust	Private sector investment in sustainability	More sustainable and resilient ecosystems and agricultural economy
Education and research	Time and labor for educational programs; community relations.		More opportunity for education and awareness.
Conservation Organizations	Scientific knowledge; relationships with communities and NGOs.	Support of local agricultural interests and ecological sustainability	Community members and local chapters are engaged and educated, local agriculture operations are stronger, have increased and new revenue streams, in harmony with ecosystems
Landowner	Investment in grasses management and access to the property	Additional revenue streams, impact to grazing nutrition efficiency	More resilient business, more net income.

***Key, Description of columns:**

Stakeholder: Who do we have an effect on? Who has an effect on us?
Stakeholder Subgroup: Can the stakeholder group be broken down into easily quantifiable subgroups?
Intended/unintended changes: What do you think will change for them?
Materiality to subgroup: Relevance/significance of change to stakeholder groups. Consistent with materiality
Inputs: What?: What do they invest?
Value: What is the value of the inputs by description or in currency?
Outputs: What changes as a result of the inputs?

6.0 Analysis of outcomes

The following paragraphs describe anticipated changes experienced by stakeholders as they were described in the one-on-one interviews conducted by EcoMetrics staff.

A stakeholder engagement element was conducted as part of the EcoMetrics analysis of the project. This element involved interviewing the relevant and applicable stakeholder representing one or more of these stakeholder groups, conducting interviews, and analyzing responses to inform the identification, quantification, and valuation of the expected outcomes.

The EcoMetrics team conducted 17 interviews with 18 individuals representing 8 stakeholder groups. For each interview, there was a lead interviewer with the discussions recorded to allow the team to review responses during results analysis. Due to geographical and time limitations the interviews were conducted on Zoom.

EcoMetrics uses a set of questions designed to learn from stakeholders how they perceive the change from prior or current conditions and what they expect from the project or proposed applications, in this case the use of native grasses vs. non-native grasses on reclamation sites (Appendix IV). This questioning is intended to learn what impacts are expected from the project and what they mean to the specific stakeholder. Where possible, and if the stakeholder was willing and able, we asked for a cursory ranking of impacts using a 1 to 5 rating system. Although not a rigorous statistical analysis, this did provide a sense of which outcomes were considered more important or impactful than others. To be able to compare results, interview results were entered into an Excel spreadsheet to allow quantitative analysis.

6.1 Outcomes Experienced by Stakeholders Engaged

Environment

While the environment could not be directly interviewed by the EcoMetrics team, our analysis utilizes stakeholder responses from conservation organizations and local government agencies to extrapolate potential environmental impacts that could influence environmental health and resilience. In analyzing various inputs and outcomes, soil stabilization, soil formation, water filtration and regulation, nutrient cycling, habitat and biodiversity benefits, and overall natural regeneration were identified as critical outcomes for the environment. In the face of historical droughts in Texas this summer (and in prior years), it was noted that the environment would benefit from the long-term implantation and use of native grasses over non-natives as they require less water overtime, promote long term soil stabilization and soil health, which can improve water regulation and filtration to the direct restoration site as well as land adjacent to the restoration sites over time. This can provide resilience for the landscape and the vegetation in drought years, which in turn can sustain wildlife habitat. Native grass mixes tend to include a rich biodiversity of plant species, which over time can support diverse wildlife species. As the grasses establish and flourish over time, the wildlife grazing, foraging, and nesting will improve, growing to support a rich diversity in animal, bird and mammal use.

Corporations

With a number of regional, state and national corporations interested in learning the benefits of native grasses for potential future investment, this stakeholder group would benefit from the reduction in long term management costs and maintenance that results from the application of native grasses vs. non-native grasses because the value created could offset the more expensive cost to maintain. Non-native grasses require regular mowing, grazing and long-term management that overtime native grasses do not require. Additionally, the enhanced wildlife benefits provided by a native landscape will over time advance a corporation's social license to operate in the area, especially as private landowner partners learn of the potential improvement to their land value and land use opportunities.

Conservation Organizations

Regional and local conservation organization interviewed cited their interest in learning best practices from this project to see how they could incorporate some of the applications of native grasses into other projects which demonstrate the long-term soil health, water retention, wildlife benefits and biodiversity that can thrive over time with the use of native grasses over non-native species. Sustainable land management practices were also over interest to these conservation organizations who prioritize wildlife habitat and biodiversity of species within the landscape.

Local Government Agencies

Local government agencies have an interest in both the wildlife benefits as well as the land management opportunities presented by native grass applications on restoration or reclamation sites. The agencies interviewed work directly with landowners, sometimes providing support in the form of grants, cost-sharing programs and/or educational resources for those interested in improving native landscapes on their land for either grazing or hunting activities, or methods in which they can enhance the overall value of the land. The local government agencies embedded within these communities also appreciate the way in which landowners communicate with each other about land management or enhancement opportunities or failures. These agencies see great potential in pilot projects in partnership with willing private landowners which can demonstrate successful native grass uses as a way to educate and inform other landowners of the potential value created in improved hunting activities that come with native wildlife habitat creation, the ability to maintain grazing through the use of a diversity of grasses that more resilient to drought conditions, and an appreciation of the aesthetic and cultural value of a return of historic, native landscapes and the biodiversity of plant and animal life that thrive as a result.

Education and Research

The scientific and research community is most interested in what they can learn and share with other experts, landowners and extension agents about the value and business case for native grass use on private land. One of their biggest concerns is the invasion of non-native grasses and the threats posed to soil health, ecosystem health, wildlife, biodiversity and water resources. The more information and best practices available to share with different landowners and "meet them where they are at" on their educational journey, the better. Projects like these help inform what education and research groups can use to improve awareness and adoption of native grasses.

Funder

Direct outcomes to the project funder of the project include the market value potential of carbon and nutrient offset credits. While the market value is variable depending on the registry, market and timing of the transactions, we believe that the market for carbon, water, and biodiversity generated or enhanced as a result of this project will only increase over time as these markets mature and evolve. Other benefits to the funder include an enhanced social license to operate in the region and perhaps the state, as the community at large, landowners and potential partners learn of the voluntary investments made to improve restoration and reclamation practices for a win-win approach for the funder, landowner, and the environment.

Land owners

With 95% of the land in Texas privately owned, landowners were one of the most important stakeholders to interview for this project. Landowners in Texas are facing increased financial burdens in the ownership and long-term management of their property. Today, cattle grazing is not profitable enough for landowners, so they must diversify their land use to support their bottom line. This diversification is in the form of oil and gas leases and/or creating hunting businesses for recreational use on their land. With such financial constraints it has proven an uphill battle for some landowners to burden the cost of purchasing native grass seed for use on their land. Ther landowner interviews noted that when demonstrating the variety of long-term benefits of native grass habitat, new, long-term opportunities can be presented to them which might increase their buy-in over time. Projects like this one can help demonstrate the increasing profitability of sustainable practices using native grasses with benefits such as improved wildlife biodiversity as wildlife like to forage, graze and nest in various native grass species, soil health, which improves water resource availability and resilience in drought conditions, and the long-term sustainability of grazing over time once a variety of native grass species is established and cattle can be rotated on the land. While this grazing might not be immediately as profitable as non-native grasses such as buffle grass, it is believed that over time it will provide for sustainable grazing as well as the other revenue streams mentioned. This pilot will also help inform landowners of the possibility of additional streams of income through carbon, water quality and biodiversity markets. There is additional SROI and ROI gained in the preservation and enhancement of their land in terms of property value and the return of native Texan landscapes. The return can also serve as an educational tools for others, to learn what native rangelands in Texas actually look like when they are returned to true native grasses.

Local Business

Increased business opportunities are considered the number one benefit for local seed businesses as a result of the project. A secondary benefit would be the improved knowledge base that would be created as a result of securing additional business from new landowners interested in new native seed mixes and different applications for native seed within the regional landscape. With improved demand, these businesses would see increased profits as well as new seed sourcing and larger supply chains.

6.2 Analysis of Stakeholder Input Data

In order to better understand the data provided by the stakeholders engaged in this effort, select statistical analyses were performed. In this analysis, stakeholder input was organized by stakeholder category. If the stakeholder self-identified with more than 1 group, that representation was honored while avoiding double-counting risk.

Analysis of survey results indicated that, in general, there was consensus of overall improvement with native species compared to non-native species. Respondents were asked to rank native vs non-native options using a 1 to 5 rating for the categories of Economic, Cultural/Social, Education/Research, Ecological/Environmental, and Community Enhancement. Whereas the non-native scoring was less than 3 out of 5 in all categories, the native scored 3.6 or greater in all categories, with three of the five categories ranking greater than 4 out 5. However, the rankings were relatively close between categories. For example, the average score for each of the five categories ranged from 2.4 to 2.8 for non-native, and 3.6 to 4.9 for native species. The lowest rank was Community Enhancement for non-native species at 2.4, and the highest rank was Ecological/Environmental for native species at 4.9.

Stakeholders were then asked to score each of the anticipated outcomes they identified on a scale of 1 to 5 for likelihood of the outcome occurring, how beneficial the expected consequence would be, and how widespread they felt the impact would be felt. This ranking exercise was for the stakeholders to give a sense of how impactful they felt the outcomes resulting from native species would be. Caution must be taken when analyzing this ranking in that stakeholder perspectives of what an outcome is varies, and there is likely overlap. However, at high level, the expectation of beneficial consequences was high at 4.45 out of 5, with likelihood at 4.2 out of 5, and how widespread was 3.2 out of 5. In general, this indicates a relatively positive expectation.

7.0 Analysis Results

7.1 EcoMetrics Approach to Benefits Analysis

As noted in Section 2.2, the SROI approach is one that starts with input information and feedback from stakeholders and ends with a compilation of quantified and valued outcomes. The process is illustrated and documented in an SROI Map. For this report, we have integrated the SROI Map into a series of progressive tables that start with basic inputs and progress to a table that gives final, corrected and adjusted values for each outcome identified.

In EcoMetrics, we divided the SROI Map into four stages, and sections 7.2, 7.3, 7.4, 7.5, and 7.6 reflect these stages. Section 7.6 is devoted to explaining the various SROI corrections that must be applied to initial outcome values in order to get a more accurate and truer picture of value created by the project. Figure 4 is a conceptual flow diagram illustrating the SROI Mapping process.

Figure 4: Conceptual SROI Mapping Flow Diagram

7.2 Inputs and Outputs- SROI Map Stages 1 and 2

The critical input included in this project is direct financial investment in planting and maintaining the land. Table 5 in Section 5 reflects Stages 1 and 2 as defined above and represents the specific stakeholder types, and how they relate to inputs and expected outputs. These outputs lead to the impacts, which include benefits, to be attributed to the stakeholders.

7.3 Outputs and Outcomes- SROI Map Stage 2 (continued)

Once we know the outputs, we can determine what changes as informed by research, direct observation, and stakeholder input. These are the outcomes. Table 6 builds on table 5 by identifying the outcomes sorted by the stakeholder that they benefit. Specifics on how these outcomes are defined and valued are explained in Table 6. Table 6 contains the actual financial proxies used whereas below these are translated into dollars per acre to be able to effectively compare native and non-native grasses.

There is of course some overlap between many of the outcomes and which stakeholder group benefits. To address this and to allow for more simplified interpretation, we have assigned the benefit to the primary beneficiary. Ecosystem services are typically organized not by stakeholder, but by service type (regulating, supporting, provisional or informational). It is possible to sort these outcomes in any manner that aligns with the project goals. For the purposes of this study, we have organized these outcomes by stakeholder to address SVI principles.

Many of these outcomes have been defined and studied extensively in academic literature. In essence, a land type might provide a combination of different benefits based on its inherent qualities (for example, trees in a forest provide high levels of carbon sequestration, wetlands can effectively dampen storm effects, etc.). Not all land types are assigned all benefits, and some land types may have higher values for certain benefits as compared to others. These proxy values are often assessed on an annual “per acre” value basis. Non-acre values assessed, though fewer, were done as “per resident” or “per student”, also on an annual basis, in this case. For this project, the main land cover types studied were native grass and non-native grass.

Table 6: Outcomes by Stakeholder

Stakeholder	Outcomes	Outcome Description (with conversion as applicable)	Calculation of Value	Proxy Non-Native $/ac or as noted	Proxy Native $/ac or as noted	Citation Number*
Academia/Research	**Scientific education**	Improved and increased the number of scientific research, educational programs and opportunities. Even though the site is not open to the public, it could provide visitation options.	The number of visitors for educational experience per year is multiplied by the amount of dollars per student per day in a classroom over the lifetime of the project.	$6/student	$6/student	18
Environment	**Soil Stabilization***	Refers to the impact of increased deep -rooted vegetation, which contributes to the retention of arable land, slope stability, and erosion control. The costs associated with erosion include reduced soil productivity, damaged roads and structures, filled ditches and reservoirs, reduced water quality, and harm to fish populations. Rotational grazing will enhance growth of vegetation above and below ground. Non-native .07 tons/ac lost Native .02 tons/ac lost	Number of acres is multiplied by the savings on avoided erosion per acre per year, over the lifetime of the project.	0.76	0.27	13
	Soil Formation	Soil formation refers to weathering of rock and accumulation of organic material in respect to soil agricultural productivity and nutrient retention.	Number of acres times value of soil formation per acre per year, over the lifetime of the project.	2.78	4.12	3, 23
	Waste Treatment	Recovering mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.	Number of acres is multiplied by the value of equivalent waste treatment to same nutrient levels per acre per year, over the lifetime of the project.	42.86	118	24
	Water Filtration*	The value of retaining water in the local ecosystem water table by way of improved infiltration.	Number of acres times value of water filtration per	11.78	25	26

			acre per year, over the lifetime of the project			
	Nutrient Cycling	Repeated pathway of particular nutrients or elements from the environment through one or more organisms back to the environment. Nutrient cycles include carbon, nitrogen, and phosphorus.	Number of acres is multiplied by the value of nutrient cycling per acre per year, over the lifetime of the project.	7.54	11.78	4, 12
	Biological Control	Management of a pest, weed or disease through the use of their natural enemies.	Number of acres is multiplied by the value of equivalent biological control by artificial means per acre per year, over the lifetime of the project.	63.3	63.3	8
	Pollinator Population Support	Creation of settings for pollinators in terms of value to the agricultural economy	Number of acres times value of pollinator habitat per acre per year, over the lifetime of the project.	5.67	25	7, 14
	Habitat and Biodiversity*	Providing shelter, maintaining biological diversity and pollinator habitat that promotes healthy ecosystems.	Number of acres is multiplied by the value per acre per year, over the lifetime of the project).	18.74	40	5, 22
	Water Regulation*	Controlling the flow of water through the environment. Includes water retention, storm flood protection and is closely related to erosion and natural water purification.	Number of acres is multiplied by the value of water regulation value per acre per year, over the lifetime of the project.	4.17	11	27
General Public	**Cultural and Aesthetic Value**	Providing opportunities for communities to retain lands with spiritual, religious, and historic importance; and enjoying and appreciating the scenery, sounds, and smells of nature.	Number of acres times the value per acre per year, over the lifetime of the project.	42.08	108	10
	Air quality – Other GHG	Providing clean, breathable air by the removal of GHG pollutants such as nitrogen dioxide, sulfur dioxide and ozone	Number of acres is multiplied by the value per acre per year, over the lifetime of the project.	115	115	16

	Carbon (C) Sequestration - Social Value	Comprehensive estimate of climate change damages such as agricultural productivity, human health, property damages from increased flood risk, etc. Native grasses sequester more carbon than non-native grasses.	Tons of C sequestered per acre per year is multiplied by the number of acres and dollar per ton of carbon social value, over the lifetime of the project.	51/ton	51/ton	17
	Nitrogen (N) Retention – Social Value*	Regenerative agriculture improves the soil by retaining N. This protects downstream systems such as: wetlands, rivers, other farms and could reduce the operation cost in water treatment plants.	Tons of N retained per acre per year is multiplied by the number of acres and dollar per ton of nitrogen social value, over the lifetime of the project.	25.37/lb	25.37/kg	21, 30
	Phosphorus (P) Retention – Social Value	Regenerative agriculture improves the soil by retaining P. This protects downstream systems such as: wetlands, rivers, other farms and could reduce the operation cost in water treatment plants.	Tons of P retained per acre per year is multiplied by the number of acres and dollar per ton of phosphorus social value, over the lifetime of the project.	339/lb	339/kg	2, 20
	Land Management Incentives / Insurance	$/acre-yr paid by the US Department of Agriculture under the Grassland Conservation Reserve Program (CRP) for following an approved CRP conservation plan (2023) to protect environmentally sensitive agricultural.	Number of acres is multiplied by the value per acre per year, over the lifetime of the project.	13	13	15
Local Economy	**Wildfire Risk Reduction**	Reduced losses due to lower wildfire potential of land cover	Number of acres times value per acre over the lifetime of the project (adjusting for NPV)	53	53	6
	Value of Livestock Grazed*	Producing livestock Non-native .22 cows/ac Native .09 cows/ac	Number of cattle per acre times value per head of livestock over the lifetime of the project.	200/head	200/head	29
Local Government	**Water Supply / Quantity**	Providing long-term reserves of usable water store as soil moisture	Number of acres times the value per acre per year, over the lifetime of the project.	34.29	64.16	11, 25

Funder	**Market Value Carbon Credits**	Increased carbon sequestration yields carbon credits Non-native .02 tons/ac Native .04 tons/ac	Tons of carbon sequestered per acre per year times the number of acres and dollar per ton of market credit value, over the lifetime of the project.	24.5/ton	24.5/ton	19, 28
	Market Value Nitrogen Credits*	Increased nitrogen retention may yield water quality credits Non-native .1.5 lbs/ac Native 3.0 lbs/ac	Pounds of Nitrogen retained per acre per year times the number of acres and dollar per pound of market credit value, over the lifetime of the project.	5.44/lb	5.44/lb	1
	Market Value Phosphorus Credits	Increased nitrogen retention may yield water quality credits Non-native 1.25 lbs/ac Native 1.25 lbs/ac	Pounds of Phosphorus retained per acre per year times the number of acres and dollar per pound of market credit value, over the lifetime of the project.	6.51/lb	6.51/lb	9

*Values corrected based on NRI analysis as per table 2.

7.4 Valuing Outcomes- SROI Map Stage 3

7.4.1 Financial Proxies

For attaching values to outcomes, we used a meta-analysis and benefits transfer approach. Our goal was to find the most up to date peer-reviewed materials to use for the calculation of financial proxies across outcomes. For this project, biophysical parameters such as carbon sequestration, soil water content and biodiversity, among others, were directly sampled and measured by TAMU-NRI. This is the ideal situation where actual site-specific data are available. These data were used in the EcoMetrics analysis.

For other parameters not measured by NRI, and where possible, we looked for the most regionally specific calculations beginning from local and regional information to the U.S. national level. Peer-reviewed figures from federal and state agencies were prioritized, depending on dates they were produced. Where these criteria could not be met for peer-reviewed proxies, recent national and international reports were used to make calculations, particularly for some of the more intangible benefits. Many of these values were drawn from data sources that have met the standard of social value as established by SVI and priority was given to projects that have been assured by this organization. The appropriate use and application of third-party proxies in this analysis was guided by internationally recognized standards.

Proxies were adjusted, as needed, to standardize units, currency, and inflation. Other corrections made to proxies include adjustments for formula inputs. If multiple proxies were deemed appropriate across different data sources for an outcome, an average was then computed and applied.

7.4.2 Analysis of NRI Results

NRI collected and analyzed data on a number of biophysical parameters across several test plots where controlled analysis of native and non-native grasses could be conducted. There was a total of approximately 22 acres of each divided into plots. One of the purposes of the analysis was to inform the EcoMetrics analysis. NRI collected information that informed the environmental outcomes such as carbon sequestration and biodiversity. Appendix III contains tables of the NRI results.

The EcoMetrics methodology used the NRI analysis in a number of ways. First, where specific quantification information was provided, it was used as the conversion rate for outcome quantification. For example, NRI calculated carbon sequestration as metric tons per hectare for each grass type. The EcoMetrics methodology was then used to calculate the tons of carbon that could be sequestered per acre per year, which was then multiplied by the financial proxies for social cost of carbon and possible market prices for offset credits. The parameters from NRI used for EcoMetrics valuation included carbon sequestration, soil runoff, water runoff, biodiversity, and nutrient retention.

Secondly, the EcoMetrics methodology used the NRI to provide further insight into the differences between grasses in cases where the financial proxy from the literature did not distinguish between grass types. For example, in the literature a composite value for biodiversity of rangelands and grasslands in dollars per acre is available but does not distinguish between grass types. Therefore, the same per acre financial proxy is used for both native and non-native grass types. However, the NRI analysis revealed that there is a greater number of sightings and a greater diversity of species types associated with native grasses than with non-native grasses. The assumption is that the actual financial value of native grasses is in reality likely greater than for non-native grasses on a per acre basis. As the actual composition of the grass type used in the peer-reviewed research to determine the value per acre proxy is highly averaged, it was not prudent to simply increase the proxy value by the increase in the percentage of biodiversity in native grasses over non-native. Instead, the annual per acre value was adjusted for this NRI data (Table 7).

Thirdly, the EcoMetrics methodology used the biomass calculation as an additional data point for the grazing nutritional value outcome, to supplement the information provided by the stakeholder input and the specific citations for that proxy. This was calculated using a cattle density per acre for grazing, whereas a cow may need more acreage of native grass to get the same nutrition as from non-native grass acreage.

In Appendix I, the far-right column of the table provides the percentage values for those outcomes that are informed by the NRI analysis, as summarized in Table 7 below.

Table 7: Adjustments to Outcome per Acre Values Based on NRI Analysis

Outcome	Relation to NRI Data	Per Acre Value from Proxy ($)	Percent Native over Non-Native (%) approximated	Corrected Per Acre Value Based on NRI ($)
Soil Stabilization	Sediment Runoff	$(-1.2)	60%	$(-0.76)
Water Filtration	Infiltration Rate	$12	114%	$25
Biodiversity/Habitat	Observation Counts	$19	116%	$40
Water Regulation	Surface Runoff	$4	153%	$11
Nitrogen Retention	Nitrates	30	100%	$76
Grazing Nutrition	Biomass	$44	(-53)%	$18

7.4.2 Market and Non-Market Values

EcoMetrics defines outcome values as “Market” and “Non-Market” values. Both are reflected in monetized terms, in this case dollars. However, Market Value is defined as a value that is directly realized by a stakeholder, usually as revenue to the funder or owner of the attribute. A typical example of Market Value is the income from carbon credit sale or direct revenue from the project. Other examples could be gains from sale of real estate or sale of goods and services. Most values however are Non-Market and relate to value created for many other stakeholders. Because most outcomes benefit the environment, the general public, other key stakeholder groups in addition to site owners and funders, the overwhelming majority of value created is typically Non-Market value.

7.4.2.1 Market Values for Carbon, Nitrogen and Phosphorus

According to TxN, carbon markets create a financial incentive for landowners to conduct management practices on their land to store carbon in the soil.. To make this practice more financially feasible, the value of carbon must be quantified, as well as the additional economic values of native rangeland vegetation to flora and fauna biodiversity, reduced erosion, water quality and storage, increased quality of forage for livestock, and socioeconomic impacts. The stacked approach of multiple co-benefits creates a holistic value of native vegetation. Also as noted in this report, the amount of carbon sequestered per acre is greater for native vs non-native grasses, thereby further strengthening the business case.

Market values for carbon are based on general price ranges per ton in the various marketplaces where offsets are transacted. This per ton value is different from, and independent of, the nonmarket "social" value of carbon. There is a great variety of market types and programs, ranging from informal bi-lateral carbon transactions to very structured and formal registries which act as central depositories of credits, and provide protocols and rigorous review of claims of sequestration. Some of these formal markets are regulated, such as in California, but the overwhelming majority operate in the voluntary marketplace. If a project wants to register credits for transactions in these formal marketplaces, it would need to follow that registry's applicable protocols and methodologies, as well as defined monitoring, reporting, and verification. It is possible that a specific program or registry may require a methodology different from or in addition to how EcoMetrics calculates carbon sequestration. Also, the EcoMetrics analysis alone does not typically conform to the level of validation and verification requirements of some registries and that would need to be done above and beyond the EcoMetrics analysis. In essence, EcoMetrics can give a sense of the potential market value of sequestered carbon, but in and by itself does not serve as an application for registering credits with any specific registry.

Values of nutrient reduction as tradable credits (nitrogen and phosphorus) are also included. These values should be interpreted as an "opportunity" value and assumes that all reductions due to land cover type would be available for transaction. However, there are only a handful of water quality trading programs in the nation and trading programs have specific rules. For example, some programs require that a percentage of reductions be "retired" and therefore not available for sale. Trading programs also have specific rules as to what reductions are acceptable, and simply because the land cover retains a certain amount of nutrients, they may not all be accepted as credits. As a proxy to help understand the potential gains from nutrient retention credits programs (should they become available), we used a national average for credits price based on other programs for nitrogen and a regional price for phosphorus. However, any program ultimately established for this area, and the corresponding marketplace, will set its own prices per credit.

Texas is exploring establishing a water quality trading program that would allow non-point source to point source trading of water quality improvement reductions, as credits, to others who can use them as partial compliance offset in discharge permits. Texas is in exploratory discussions with Louisiana who already has established such a program. Louisiana's program allows compliance offsets as non-point source to point source transactions.

7.5 Corrections- SROI Map Stage 4

In order to ensure consistency with the SROI process, it is necessary to correct the initial values of the outcomes to be more reflective of the changes that are actually due to the project or activity. In other words, we are determining the "net value impact." This is done via several corrections as defined in 7.5.1 through 7.5.8. Because this study was a comparative analysis of two approaches on test plots, and not a full-scale project typical of EcoMetrics, some of the corrections required by SVI are either not applicable or have been modified as described below.

7.5.1 Counterfactual (Deadweight)

Deadweight is defined as the percentage of a benefit that would have occurred anyway, if none of the changes defined by the scenario were to occur. As this is a comparative analysis of two land cover type options, deadweight issues have been addressed by doing a separate analysis for each grass type, followed by a comparison of the delta, or change, of outcome values. This approach accounts for the deadweight concept by subtracting the current condition value from expected condition with the understanding that the current condition is what would have happened anyway if the project is not implemented. The process of determining the delta value for all outcomes is a more comprehensive method of addressing deadweight than making individual corrections to selected outcomes.

7.5.2 Attribution

Attribution requires values to be corrected to ensure that a benefit is not attributed to the project which should be attributed to others or other unrelated conditions. Because the analysis was focused on native vs non-native grasses, the attribution rate for all stakeholder group outcomes is 0%.

7.5.3 Displacement

Displacement means correcting for a benefit that would have occurred if the project did not occur but have now been "displaced" by the project. As with deadweight, the delta value determination addresses any displacement.

7.5.4 Drop-Off

Drop-off relates to a decrease in value of benefits over time. This correction does not apply to this comparative analysis in that we are making an "instant in time" valuation comparison. Future analysis when applied to specific sites may include projections over a specific number of years. In those cases, corrections can be made for drop-off.

7.5.5 Testing Outcomes for Materiality

Outcomes are tested for materiality before being included in the final analysis. Figure 5 and Table 8 depict the process of determining materiality and is based on relevance and significance. The outcomes of the project were determined by first analyzing collected material from the qualitative phase of research. Once outcomes were identified by stakeholder group, third-party (secondary source) literature were consulted to validate research findings within broader third-party literature and other relevant studies.

Depending on the stakeholder group, causality between the outcomes was determined based on stakeholder involvement and/or applicable third-party literature. All outcomes are relevant because they are directly linked to the activity, as no other factors or inputs were determined to have caused any of the outcomes identified by stakeholder groups and third-party literature. In short, the first event in the chain of events is planting of the grass, to which all identified outcomes are directly linked. That is, through the establishment of grasses, the various outcomes are achieved specific to different stakeholder groups. The EcoMetrics methodology considers all outcomes mentioned by a stakeholder as significant and relevant, that is, if it was articulated by a member of a stakeholder group during the qualitative phase of the research. For the Environment stakeholder, the only group that cannot speak for itself, materiality was determined by third-party literature and EcoMetrics LLC subject matter experts.

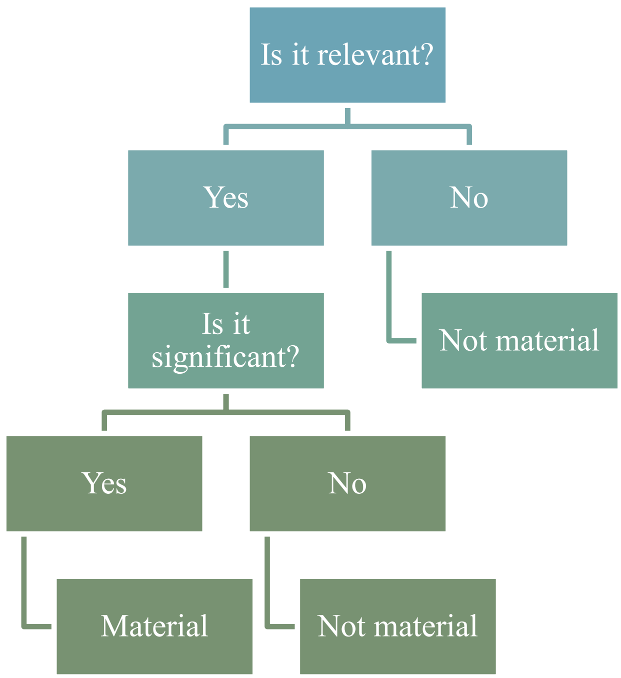

Figure 5: Determining Materiality Through Relevance and Significance

Table 8: Materiality of Outcomes

Stakeholders	Outcome	Was the Outcome Identified by Stakeholders During Qualitative Phase of Research?	Was the Outcome Confirmed by Third Party Research?
Academia/Research	Scientific education	YES	YES
Environment	Soil Stabilization	YES	YES
	Soil Formation	YES	YES
	Waste Treatment	YES	YES
	Water Filtration	YES	YES
	Nutrient Cycling	YES	YES
	Biological Control	YES	YES
	Pollinator Population Support	YES	YES
	Habitat and Biodiversity	YES	YES
	Water Regulation	YES	YES
General Public	Cultural and Aesthetic Value	YES	YES
	Air Quality - Other GHG	NO	YES
	Carbon sequestration- social value	YES	YES
	Nitrogen Retention- social value	YES	YES
	Phosphorus Retention- social value	YES	YES
	Land Management Incentives / Insurance	NO	YES
Local Economy	Wildfire Risk Reduction	YES	YES
	Value of Livestock Grazed	YES	YES
Local Government	Water Supply/Quantity	YES	YES
Funders	Market value of Carbon Credits	YES	YES
	Market value of Nitrogen Credits	NO	YES
	Market Value of Phosphorus Credits	NO	YES

Where an outcome was not mentioned by a stakeholder but is likely to apply based on technical expertise and prior experience of EcoMetrics LLC, it is noted as "NO" for the stakeholder and "YES" for third party research. This occurs because based on the stakeholder's background and knowledge, they may not be aware that such a benefit exists. It would be prudent to make stakeholders aware of these additional benefits that exist.

7.5.6 Unintended or Negative Outcomes

Methodologies were designed to capture unintended consequences or negative outcomes of using native vs non-native grasses for the restoration. It was clear from the stakeholder input that native grasses are preferred and provide much value. The landowners mentioned that they thought native grasses are not as beneficial for grazing as non-native grasses. In essence, the perception seemed to be that whereas native grasses do help with ecosystems, especially biodiversity, non-native grasses are assumed to have more nutrients levels and are less costly to plant. This perception is not entirely true and is highly dependent upon management intensity, establishment duration, and other factors.

7.5.7 Statement of Risks of Overclaiming

All outcomes are directly associated with the grass planting.

7.6 Comparative Analysis Results

The valuation models were constructed in two different models and two different parts (non-market and market values). The models included the following:

1. The valuation of the non-native grasses.
2. The valuation of the native grasses.

Table 9 (a copy of Table 1) and Appendix I show the processed and aggregated model results. Appendix I goes into greater detail of the valuation results by not only determining the annual per acre value, but also determining the total value of all of the acres tested for each grass type, as well as the accumulated value over a 25-year time horizon. The 25-year interval was chosen to demonstrate how value increases over time, but the analysis could be set for any desired time period. The NRI data was in part averaged over a 25-year period to determine annual rates (Appendix III). The value presented for the 25-year time horizon information in this study are the net valuations with a 3% discount rate applied. All values are presented in USD$ 2023.

Table 9: Comparative Annual per Acre Values of Outcomes for Native vs Non-native Grasses

Stakeholders	Outcomes	Annual per Acre Non-Native ($)	Annual Per Acre Native ($)	Annual per Acre Native minus Non-Native ($)
Academia/ Research	Scientific Education	$0	$28	$28
Total Academia/ Research		$0	$28	$28
Environment	Total Soil Stabilization*	$(-0.76)	$(-0.27)	$0.49
	Total Soil Formation	$3	$4	$1
	Total Waste Treatment	$43	$118	$75
	Total Water Filtration**	$12	$25	$13
	Total Nutrient Cycling	$8	$12	$4
	Total Biological Control	$63	$63	$0
	Total Pollinator Population Support	$6	$25	$19
	Total Habitat and Biodiversity**	$19	$40	$21
	Total Water Regulation**	$4	$11	$7
Total Environment		$157	$298	$140
General Public	Total Cultural and Aesthetic Value	$42	$108	$66
	Total Air Quality - Other GHG	$115	$115	$0
	Total Carbon sequestration-social value	$1	$2	$1
	Total Nitrogen Retention- social value**	$30	$76	$30
	Total Phosphorus Retention-social value	$424	$424	$0
	Total Land Management Incentives / Insurance	$13	$13	$0
Total General Public		$625	$738	$97
Local Economy	Total Wildfire Risk Reduction	$53	$53	$0
	Total Value of Livestock Grazed**	$44	$18	$(-23)

Total Local Economy		$97	$71	$(-23)
Local Government	Water Supply/Quantity	$34	$64	$30
Total Local Government		$34	$64	$30
Funders	Total Market value of Carbon Credits	$1	$1	$0
	Total Market value of Nitrogen Credits**	$8	$16	$8
	Total Market Value of Phosphorus Credits	$8	$8	$0
Total Funders		$17	$25	$8

Total Value Created	**Non-Native Annual Per Acre**	**Native Annual Per Acre**
Non-Market Total Present Value	$913	$1,199
Market Total Present Value	$17	$25
Total Value	$930	$1,224

*Soil Stabilization is based on NRI soil runoff information, and the financial proxy is based on cost/ton of runoff. The lower per acre value for native grasses means less runoff occurs, which is a positive outcome.

** Corrected proxy value-equivalent based on NRI quantification analysis

Appendix I illustrates the value created for each outcome for each grass type in terms of annual per acre value, annual value for the entire acreage of test plots, and a conceptual total value created over a 25-year time horizon. Table 9 includes the annual per acre values for each grass type, and the delta value between the two. Specifics from the table and Appendix I indicate that:

- Overwhelmingly, native grasses create more value per acre than non-native grasses.
- In some cases, the per acreage value is the same for native and non-native grasses, and hence the delta, or difference, appears as zero. This does not mean there is no value, only that there is no difference between the grass types using the proxy information that was available.
- Some outcomes used a per acre financial proxy which did not distinguish between grass types or a proxy that is based on some other metrics, such as tons, pounds, or head of cattle based on available peer research used. However, the quantification of the attribute was informed by the NRI study which allowed a "correction" to the per acre value.
- Annual aggregate values for outcomes are provided for the total acreage. This is to give a sense of total value created for the approximate 22 acres of each grass type tested. As this was an actual restoration of disturbance, the total value created does give an indication to TxN and EOG of value created by this specific restoration.
- To give a sense of change over time, values are provided for a hypothetical 25-year time horizon. However, the analysis could be completed for any time period desired.

Table 9 also provides a financial summary of the total value created. This summary indicates that even though the native grass plots acreage was slightly smaller than non-native (21.74 vs 21.94 acres), the native grasses still created more total value annually, and over the 25-year time horizon. An ROI could be determined if this value created is compared against investment costs. Detailed cost information was not included, however stakeholders noted that the cost for seeds is approximately $20 more per acre for native grasses.

7.7 Sensitivity Analysis

7.7.1 Discount Rate Analysis

When doing a typical predictive EcoMetrics analysis for scenarios that look into the future, sometimes a time horizon is used. This allows the value accumulated over several years to be determined. When this kind of multi-year projection is done, it requires compensating for uncertainty and changes in dollar values. A discount rate analysis can be done to see how net present value varies based on an assumed discount rate. This analysis is often conducted to help policy makers and project planners understand the future net benefits of an initiative. Particularly with environmental based efforts, the time scale for change is often long. For this comparative analysis, we examined a “snapshot in time” and did not do a multi-year analysis hence a discount rate analysis is not applicable.

7.7.2 Sensitivity Analysis

Given the uncertainty that any predictive model possesses, it is important to consider the ranges provided for the estimates of value created. At this stage where we are comparing approaches that would be applied to specific projects. As those projects materialize, it would be possible to identify ranges for selected outcomes as appropriate. For example, some locations may have different proxies than used herein, or there might be uncertainties in quantification. The NRI work was significant in providing very specific biophysical parameter analysis which eliminated uncertainty in quantification of key outcomes. Some examples of issues of sensitivity would be market values for carbon, nitrogen, or phosphorus credits, changing market value of livestock, and actual seed mix characteristics.

7.8 Limitations

Primary vs Secondary Research

Given the practical constraints of this project, obtaining primary research studies for all the proxies included was not feasible. To provide a robust report given these limitations, extensive research was conducted to apply a range of appropriate social and ecosystem services proxies where direct study inputs are not available. The credibility of the sources that are referenced are highly scrutinized, primarily peer reviewed academic journal articles or publications by highly regarded and established organizations such as governments and foundations. Despite the high standards of research, there may always be gaps in research, dynamic and changing landscapes from when the regional research might have been conducted, issues of regional applicability, and other financial and economic factors that may influence the study. In general, the meta-analysis and benefits transfer approach is a widely accepted economic method of valuation, despite its limitations.

Environmental and Economic Systems are Dynamic

It is important to note that both environmental and economic systems are dynamic and can be difficult to predict. Environmental systems can be sensitive to unanticipated climate events, such as wildfires and destructive flooding. The aftermath could have significant impact on the ecosystem services valued.

Stakeholder Data

An increased number and more balanced stakeholder participation across stakeholder groups would offer a more robust analysis of input. Other potential limitations include the stakeholder's understanding of the questionnaire, uncaptured bias, and the comprehensiveness of information collected. It is not always possible to capture important elaboration of feedback or to clarify the objective of the questions asked to ensure proper interpretation of the survey.

Refinement of Current Inputs and Identifying Missing Outcomes

Refinement of current valued outcomes, with the further collaboration of onsite field experts and relevant academic groups, could lead to the integration of more precise data in this model. In addition, further engagement with local experts and stakeholders may identify more outcomes of value than represented here. For example, whereas we heard from stakeholders that non-native grasses are more nutritious and less costly than native grasses, we do not have a full picture of the quantitative differences of those costs for these specific locations. Those specific values would change from site to site.

8.0 Conclusions and Recommendations

8.1 Conclusions

This study evaluates the market and non-market value of the environmental, economic, and social benefits of native vs non-native grasses for restoration of disturbed land. In this analysis, integrated social value was quantified using the EcoMetrics model, which was built on the guiding principles of SVI's SROI Methodology. The SVI approach concerns an in-depth, evidence-based understanding of change for a full range of community stakeholders with recognition of both positive and negative changes as well as intended and unintended outcomes. Value in this context refers in part to the relative importance placed by a stakeholder group on one potential outcome over another. Assigning these valuations using SVI principles requires the use of financial proxies as many of the identified outcomes are difficult to quantify using conventional accounting practices.

As these were test plots focused on comparing the impacts of using native vs non-native grasses for restoration, the important results are the per unit values for the outcomes which can be compared between the different grasses. However, these test plots leverage actual restoration of land disturbance at a ranch, and therefore the total value created, albeit for a small acreage, is value created for the relevant stakeholders.

Overall, the analysis shows that native grasses provide more environmental, economic, and social benefits than non-native grasses.

The analysis revealed three key highlights:

- The findings revealed that overwhelmingly, the native grasses create a greater aggregated value per acre ($1,224/acre) than non-native grasses ($930/acre).

- The results indicate that promoting native grasses for oil and gas right-of-way restoration will provide more value for more stakeholders, including the landowner, even if the seed, planting, and maintenance costs are greater.
- The NRI study provided highly valuable quantification information of key biophysical parameters that allowed for more accurate adjustments of projected benefits quantification and valuation proxies and methodologies.

8.2 Recommendations

Based on the analysis and findings, the following actions are recommended:

- *Continued stakeholder engagement.* Because each project is unique, application of this work to other sites and situations will require revising and supplementing the stakeholder feedback used herein to ensure other projects are reflecting the appropriate outcomes and proxies.
- *Communicate the impact.* Comparative analysis between native and non-native grasses can be used to communicate the value of using native grasses. This quantitative information can be used to promote and make the business case for native grasses, even though the seed and management cost are higher than non-native grasses.
- *Measure the outcomes of specific projects.* Using the results of this analysis, evaluate other actual projects to continue to build examples of native vs non-native grass use.

Appendix I – Table A1: Comparative Values of Outcomes for Native vs Non-native Grasses

Table A1: Comparative Values of Outcomes for Native vs Non-native Grasses

Stakeholders	Outcomes	Net Present Value-Non-Native Annual	Net Present Value-Non-Native 25 years	Annual per Acre Non-Native	Net Present Value-Native Annual	Net Present Value-Native 25 years	Annual Per acre-Native	Native minus Non-Native per acre	Native minus Non-Native-Annual	Native minus Non-Native- 25 Year
Academia/ Research	Scientific Education	$0.00	$0.00	$0.00	$601.00	$11,066.30	$27.64	$27.64	$601.00	$11,066.30
Total Academia/ Research		**$0.00**	**$0.00**	**$0.00**	**$601.00**	**$11,066.30**	**$27.64**	**$27.64**	**$601.00**	**$11,066.30**
Environment	Total Soil Stabilization	($16.68)	($307.02)	($0.76)	($5.87)	($41.76)	($0.27)	$0.490	$10.81	$265.26
	Total Soil Formation	$61.00	$1,123.07	$2.78	$89.57	$1,649.24	$4.12	$1.34	$28.57	$526.17
	Total Waste Treatment	$940.35	$17,314.78	$42.86	$2,565.32	$47,235.61	$118.00	$75.14	$1,624.97	$29,920.83
	Total Water Filtration	$258.46	$4,758.93	$11.78	$544.00	$10,008.00	$25.02	$13.24	$285.54	$5,249.07
	Total Nutrient Cycling	$165.42	$3,046.05	$7.54	$256.10	$4,715.56	$11.78	$4.24	$90.68	$1,669.51
	Total Biological Control	$1,388.80	$25,572.21	$63.30	$1,376.14	$25,339.10	$63.30	$0.00	($12.66)	($233.11)
	Total Pollinator Population Support	$124.40	$2,290.59	$5.67	$543.50	$10,007.54	$25.00	$19.33	$419.10	$7,716.95
	Total Habitat and Biodiversity	$411.15	$7,570.67	$18.74	$870.00	$16,012.00	$40.02	$21.28	$458.85	$8,441.33
	Total Water Regulation	$91.49	$1,684.62	$4.17	$239.00	$2,401.81	$10.99	$6.82	$147.51	$717.19
Total Environment		**$3,424.39**	**$63,053.90**	**$156.08**	**$7,679.76**	**$139,459.70**	**$297.97**	**$141.89**	**$4,255.37**	**$54,273.20**
General Public	Total Cultural and Aesthetic Value	$921.48	$17,991.64	$42.00	$2,347.92	$44,615.36	$108.00	$66.00	$1,426.44	$26,623.72
	Total Air Quality - Other GHG	$2,523.10	$46,458.21	$115.00	$2,500.10	$46,034.71	$115.00	$0.00	($23.00)	($423.50)
	Total Carbon sequestration- social value	$26.77	$492.82	$1.22	$44.35	$816.61	$2.04	$0.82	$17.58	$323.78

	Total Nitrogen Retention- social value	$833.64	$15,349.88	$38.00	$1,654.63	$30,466.97	$76.11	$38.11	$820.99	$15,117.09
	Total Phosphorus Retention- social value	$9,297.08	$171,188.41	$423.75	$9,212.33	$169,627.91	$423.75	$0.00	($84.75)	($1,560.51)
	Total Land Management Incentives / Insurance	$285.22	$5,251.80	$13.00	$282.62	$5,203.93	$13.00	$0.00	($2.60)	($47.87)
Total General Public		**$13,887.29**	**$256,732.77**	**$632.97**	**$16,041.95**	**$296,765.48**	**$737.90**	**$104.93**	**$2,154.66**	**$40,032.71**
Local Economy	Total Wildfire Risk Reduction	$1,169.40	$24,725.58	$53.30	$1,158.74	$23,346.80	$53.30	$0.00	($10.66)	($1,378.78)
	Total Value of Livestock Grazed	$965.36	$17,775.32	$44.00	$391.32	$7,205.44	$18.00	($26.00)	($574.04)	($10,569.88)
Total Local Economy		**$2,134.76**	**$42,500.90**	**$97.30**	**$1,550.06**	**$30,552.24**	**$71.30**	**($26.00)**	**($584.70)**	**($11,948.66)**
Local Government	Water Supply/Quantity	$752.32	$13,852.62	$34.29	$1,394.83	$25,683.37	$64.16	$29.87	$642.51	$11,830.75
Total Local Government		**$752.32**	**$13,852.62**	**$34.29**	**$1,394.83**	**$25,683.37**	**$64.16**	**$29.87**	**$642.51**	**$11,830.75**
Funders	Total Market value of Carbon Credits	$12.86	$236.75	$0.59	$21.30	$392.31	$0.98	$0.39	$8.44	$155.56
	Total Market value of Nitrogen Credits	$179.03	$3,296.52	$8.16	$354.80	$6,532.93	$16.32	$8.16	$175.77	$3,236.41
	Total Market Value of Phosphorus Credits	$178.53	$3,287.43	$8.14	$177.39	$3,257.46	$8.16	$0.02	($1.14)	($29.97)
Total Funders		**$370.42**	**$6,820.69**	**$16.88**	**$553.49**	**$10,182.69**	**$25.46**	**$8.58**	**$183.07**	**$3,362.00**
Non-Market Total PV Value		**$20,199**	**$376,140**		**$26,667**	**$466,777**				
Market Total PV Value		**$370**	**$6,820**		**$553**	**$10,183**				
Total Value		**$20,569**	**$382,960**		**$27,220**	**$476,960**				

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Appendix III – NRI Data and Analysis Tables

Table A2: Treatments

Treatment Site	Size (ha)	Grazing	Previous Management
Native Grassland	5.4	Yes	Brush management and seeded with native grasses
Non-native Grassland	5.4	Yes	Brush management and seeded with non-native grasses
Restored Pad	3.4	No	Imported topsoil and seeded with native grasses
Unrestored Pad	3.5	Yes	No management

Table A3: Simulated Soil and Carbon

Treatment	pH	Nitrate (g/mt)	Mineral Phosphorus (g/mt)	Electrical Conductivity (mmho/cm)	Soil Water in Profile (mm)	Soil Water in Root Zone (mm)	Surface Runoff (mm)	Sediment Loss in Runoff (mt/ha/yr)	Biomass (mt/ha)	Bulk Density (mt/m^3)	Organic Carbon (%)	Carbon Sequestration Rate (mt/ha/yr)
Native Grassland	7.55	0.18	10.26	0.12	386.65	13.5	3.11	0.06	5.28	1.22	1.92	0.09
Non-native Grassland	7.6	0.18	9.98	0.12	387.75	15	7.88	0.15	6.63	1.22	1.71	0.05
Unrestored Well Pad	7.6	0.3	8.26	0.12	395.15	22.45	8.85	0.27	2.78	1.22	1.89	0.07
Restored Well Pad	7.68	0.18	10.26	0.12	389.75	16.95	3.04	0.07	2.91	1.22	1.63	0.09

Simulated values represent average annual values, averaged over the 25-year simulation period. Simulated biomass values represent averages for the months of May (Spring) and September (Fall), across all simulated years.
All measured values represent data collected in May and August/September 2022. Simulated P is mineral P only.

Table A4: Measured Soil

Treatment	Organic Carbon (%)	Organic Matter (%)	pH	Nitrates (g/mt)	Electrical Conductivity (mmho/cm)	Bulk Density (t/cubic meter)	Infiltration Rate (in/hr)
Native Grassland	1.8	3.09	7.6	7.21	0.12	1.22	8.94
Non-native Grassland	2.09	3.6	7.75	3.44	0.1	1.19	4.17
Unrestored Pad	1.63	2.8	7.76	24.91	0.26	1.44	4.98
Restored Pad	1.39	2.4	7.66	3.85	0.37	1.25	5.34

Actual measured values from study sites. Data was used to calibrate modeled estimates.

Table A5: Vegetation

Treatment	Percent Native (%)	Richness (# of species)	Evenness (# of identifications)	Shannon Diversity (H')	Simpson Diversity (1-D)
Native Grassland	97.25	27	243	1.89	0.71
Non-native Grassland	47.25	21	190	1.72	0.69
Unrestored Pad	44.75	24	242	1.78	0.7
Restored Pad	60.75	31	270	1.88	0.71

Table A6: Vegetation Biomass (t/ha)

Treatment	Spring Biomass	Fall Biomass	Average
Native Grassland	2.35	0.41	1.38
Non-native Grassland	1.19	0.28	0.735
Unrestored Pad	1.09	0.25	0.67
Restored Pad	4.02	0.6	2.31

Table A7: Biodiversity

Treatment	Taxa and Guilds	# of Unique Taxa	# of Observations	Shannon Diversity Index	Simpson Diversity Index
Native Grassland	Birds	42	278	3.226	0.95
	Bats	5	411	0.723	0.33
	Small Mammals	5	103	1.261	0.68
	Meso-Large Mammals	7	119	0.913	0.44
	Herpetofauna	8	19	1.645	0.78
	Invertebrates	14	2,998	1.855	0.81
	Total	82	3,928	---	---
Non-Native Grassland	Birds	27	134	2.895	0.93
	Bats	5	456	0.516	0.24
	Small Mammals	4	19	1.136	0.66
	Meso-Large Mammals	5	31	1.176	0.66
	Herpetofauna	3	4	NA	NA
	Invertebrates	13	1,287	1.768	0.78
	Total	58	1,931	---	---
Restored Pad	Birds	26	180	2.456	0.86
	Bats	5	1,001	0.314	0.12
	Small Mammals	4	120	0.676	0.33
	Meso-Large Mammals	6	113	0.895	0.46
	Herpetofauna	6	20	1.446	0.73
	Invertebrates	13	5,429	1.322	0.56
	Total	61	6,863	---	---

Unrestored Pad	Birds	52	226	3.535	0.96
	Bats	5	432	0.576	0.25
	Small Mammals	7	52	1.236	0.62
	Meso-Large Mammals	7	53	0.946	0.42
	Herpetofauna	1	6	0	0
	Invertebrates	14	2,294	1.515	0.65
	Total	87	3,063	---	---
Native + Restored Pad	Birds	48	458	3.143	0.93
	Bats	5	1,412	0.466	0.19
	Small Mammals	6	223	1.063	0.53
	Meso-Large Mammals	8	232	0.946	0.45
	Herpetofauna	11	39	1.768	0.77
	Invertebrates	13	8,427	1.585	0.68
	Total	92	10,791	---	---
Non-Native + Unrestored Pad	Birds	57	360	3.521	0.96
	Bats	5	888	0.553	0.25
	Small Mammals	7	71	1.417	0.71
	Meso-Large Mammals	8	84	1.139	0.56
	Herpetofauna	3	10	NA	NA
	Invertebrates	13	3,581	1.73	0.76
	Total	94	4,994	---	---

Appendix IV – Survey

Name
Contact Information

Stakeholder Information

		If Other, please specify	As this type of stakeholder, why are you interested in this project?
Primary Stakeholder Group			
Secondary Stakeholder Group			
Additional Group (if applicable)			
Additional Group (if applicable)			

NOTE: This specific proejct was to assess the impacts and value of using native grasses vs non-native grasses in oil field land use relcamation. Lessons learned from this pilot proejct will inform future practices.

Current and Future Use

What are your or your organization's current use of native grasses instead of non-native grasses be affected by the project?	If Other, please specify	What impact does the grass type (native vs non-native) have on your activites or operations?	What is the likelihood that your or your organization's use of native grasses instead of non-native grasses **increase** as a result of the project?	What would the frequency of your or your organization's use change to?	If you expect an **increase**, why would this increase happen?	What is the likelihood that your or your organization's use of native grasses instead of non-native grasses will **decrease** as a result of the project?	What would the frequency of your or your organization's use change to?	If you expect a **decrease**, why would this decrease happen?

How do you think the use of native grasses vs non-native grasses will alter the use and value of sites?

Current Value and Impacts of Site
For each of the following impact categories, rank on a scale of 1-5 the value of the land surrounding the project to you and your organization?
Primary Stakeholder Perspective

Category	**Value Rating (1-5)**	**Specific Values* (if answered 2-5)**	**Examples of Specific Values**
Economic			Including local business, operations
Cultural/Societal			Including: historical significance, family traditions, cemeteries etc.
Education/Research			Including: K-12 education, university researcher, eco-tourism.
Ecological/Environmental			Including: Habitat protection, environmental quality, restoration, and conservation.
Community Enhancement			Including: Quality of life issues, resilience, etc

* To the best detail available, what is the impact under the category that prompted the rating.
1=No Value/Impact, 5=Significant Value/Impact

Defining Outcomes

What positive outcomes could this	**How likely is this outcome?**	**Benefit of consequences?**	**How wid**	**Over what period of time?**	**Comments**

What negative outcomes could this project have? Please list below	How likely is this outcome?	Severity of consequences?	How widespread?	Over what period of time?	Comments

Considering the various kinds of outcomes of this site and the planned expansion, what do you think the most direct outcome will be for you or your organization?

Anticipated Value and Impacts of Project

For each of the following impact categories, rank on a scale of 1-5 the impact of the solar/ag project?

Primary Stakeholder Perspective

Category	**Value Rating (1-5)**	**Specific Values* (if answered 2-5)**	**Examples of Specific Values**
Economic			Including local business, and operations
Cultural/Societal			Including: historical significance, family traditions, cemeteries etc.
Education/Research			Including: K-12 education, university researcher, eco-tourism.
Ecological			Including: Habitat protection, environmental quality, restoration, and conservation.
Community Enhancement			Including: Quality of life issues, resilience, etc

* To the best detail available, what is the impact under the category that prompted the rating.

1=No Value/Impact, 5=Significant Value/Impact

Secondary Stakeholder Perspective

Category	**Value Rating (1-5)**	**Specific Values (if answered 2-5)**	**Examples of Specific Values**
Economic			Including local business, operations
Cultural/Societal			Including: historical significance, family traditions, cemeteries etc.
Education/Research			Including: K-12 education, university researcher, eco-tourism.
Ecological			Including: Habitat protection, environmental quality, restoration, and conservation.
Community Enhancement			Including: Quality of life issues, resilience, etc

* To the best detail available, what is the impact under the category that prompted the rating.

1=No Value/Impact, 5=Significant Value/Impact

Monetary Values

Is this a good use of funding to the region?

Is this project important enough that it would be worth more than the current funding? If so, how much more?

Do you think this project costs too much money and some of the funds should be used for other purposes? What purposes? How much?

Plot Area

Would the money have been better spent if the project was done elsewhere?